Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supplementary Information

For

Spectroscopic Investigations of Electron and Hole Dynamics in $MAPbBr_3$ Perovskite Film and Carrier Extraction to PEDOT Hole Transport Layer

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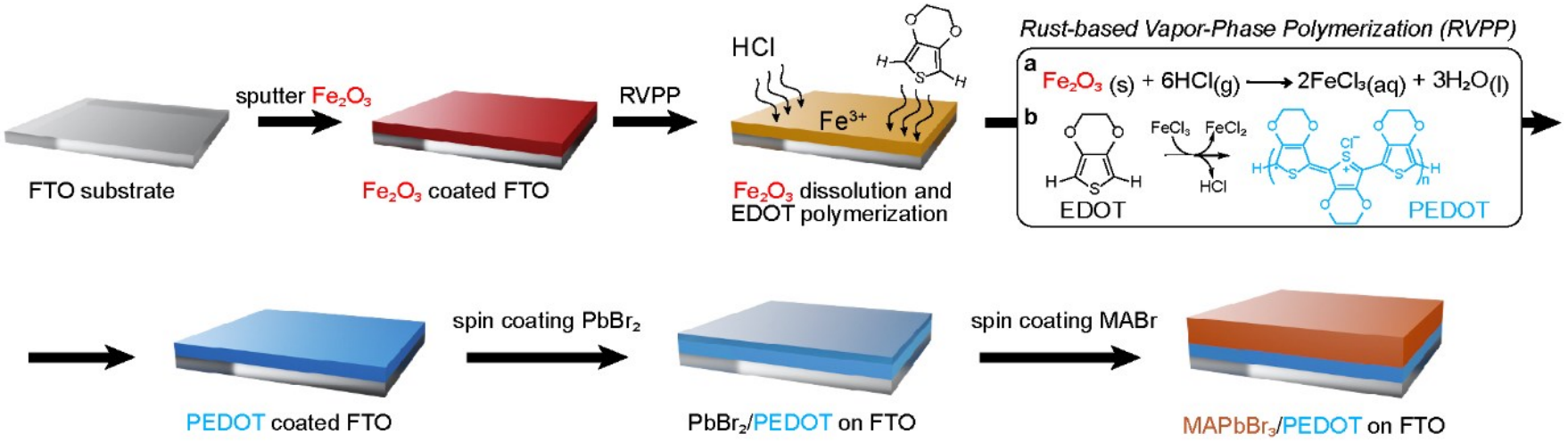

Figure S1. Schematic of RVPP-PEDOT/FTO fabrication and its mechanism for the liberation of Fe^{3+} and formation of RVPP-PEDOT via step-growth polymerization.

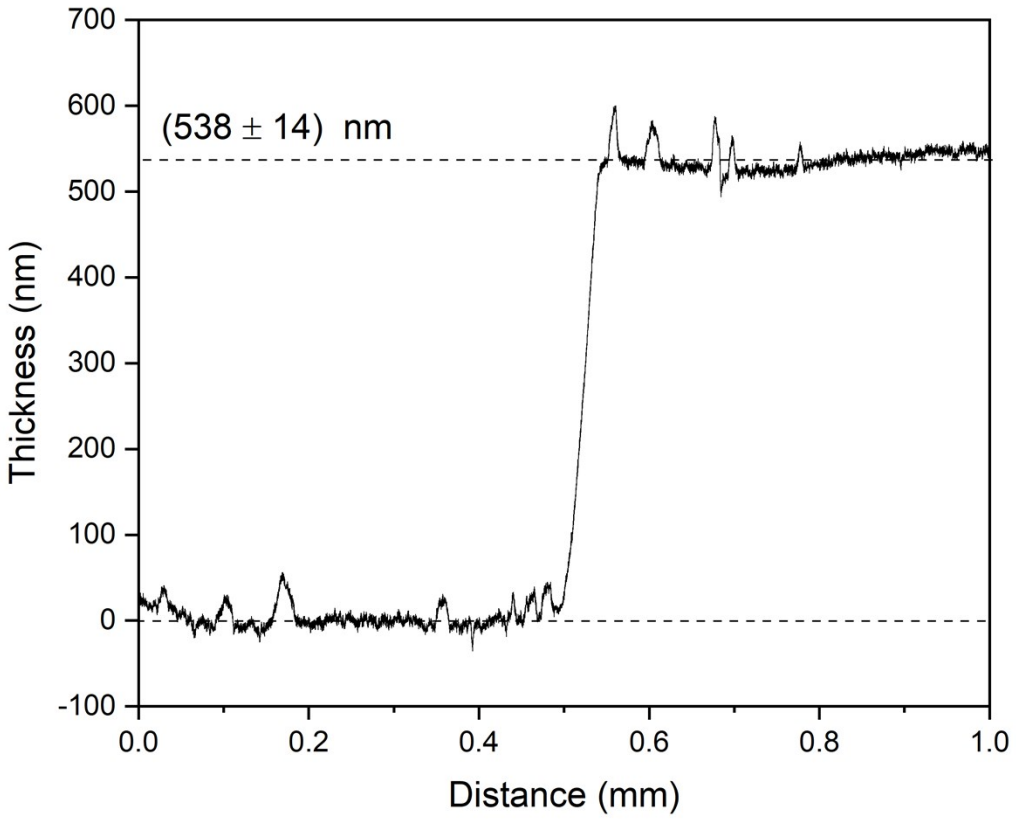

Figure S2. Profilometry of the $MAPbBr_3$ film deposited on the FTO support.

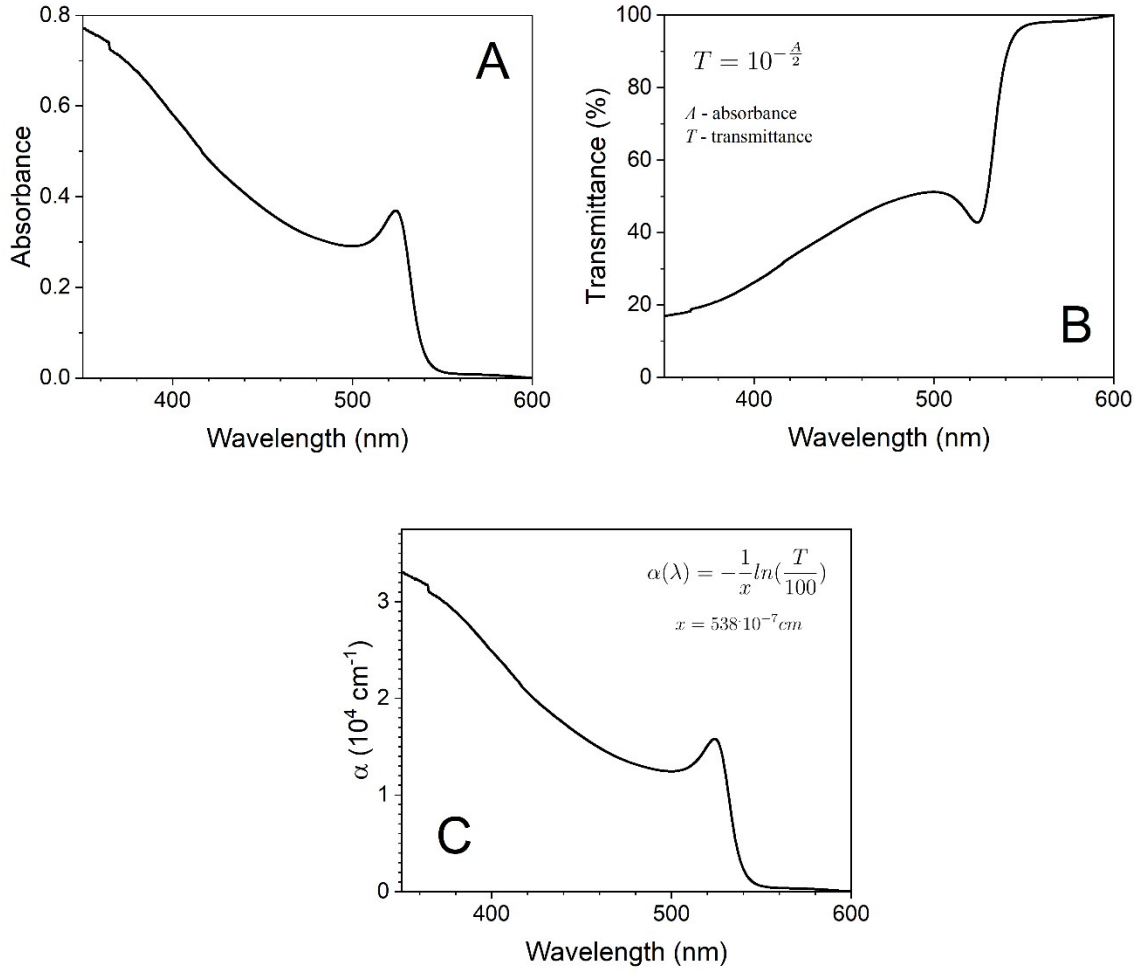

Figure S3. Conversion of absorption spectrum of the 538-nm thick perovskite film to absorption coefficient profile. (A) absorption spectrum, (B) transmittance spectrum, (C) absorption coefficient profile. Conversion formulas for each step are provided in the corresponding panel.

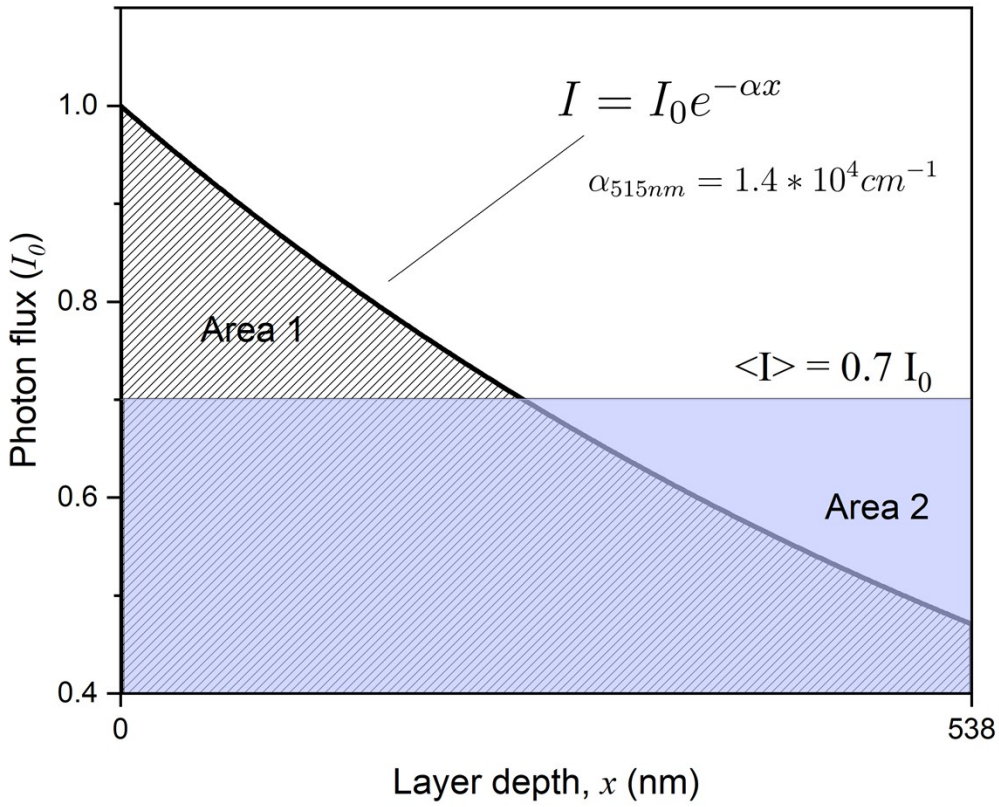

Figure S4. Calculation of average I_{exc} for 538-nm thick perovskite film. The <*I*> is assumed as $\langle I\rangle \times x\ (=538\ nm) = \int_0^{538} I(x)$ *I*(*x*) for which as depicted on the graph (shaded Areas 1 and 2 are equal).

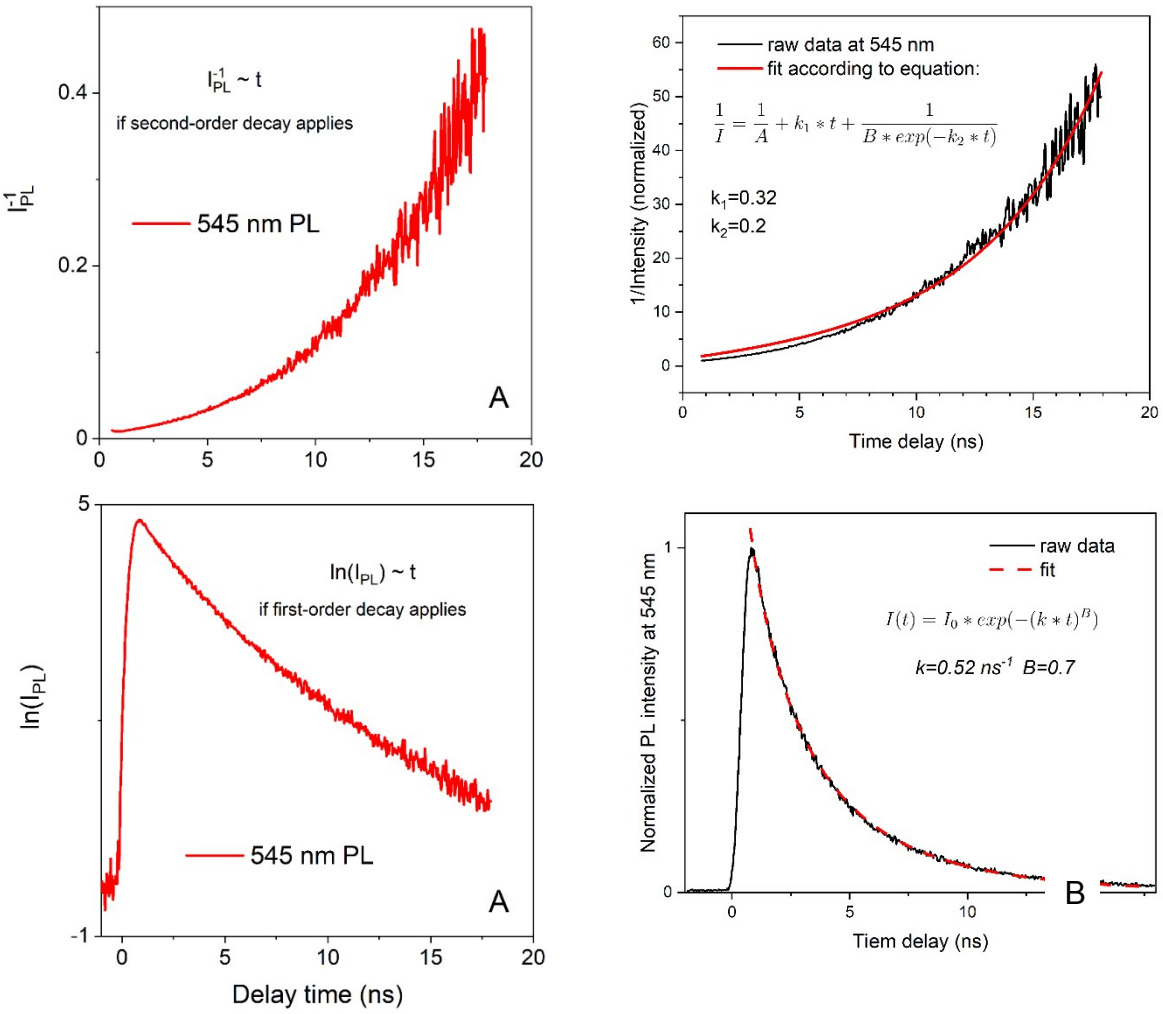

Figure S5: Empirical determination of character of photoluminescence decay dynamics. (A) Purely bimolecular recombination should give inverted PL intensity (I_{PL}^{-1}) in the form of linear function of time delay *t* as it is a second-order decay process. However, it is apparent it is not the case here. (B) If recombination occurs according to monomolecular recombination, ln(I_{PL}) will be a linear function of time delay t as it is first-order decay process. The plot shows that this may be the case, but two different decay rates are most likely involved in the recombination process. (C) Fitting of the 1/I_{PL} curve according to sum of first and second order decays does not provide good fit. (D) Fitting done according to stretched exponential decay provides PL decay lifetime of ~1.9 ns. Refer to the main text for more details.

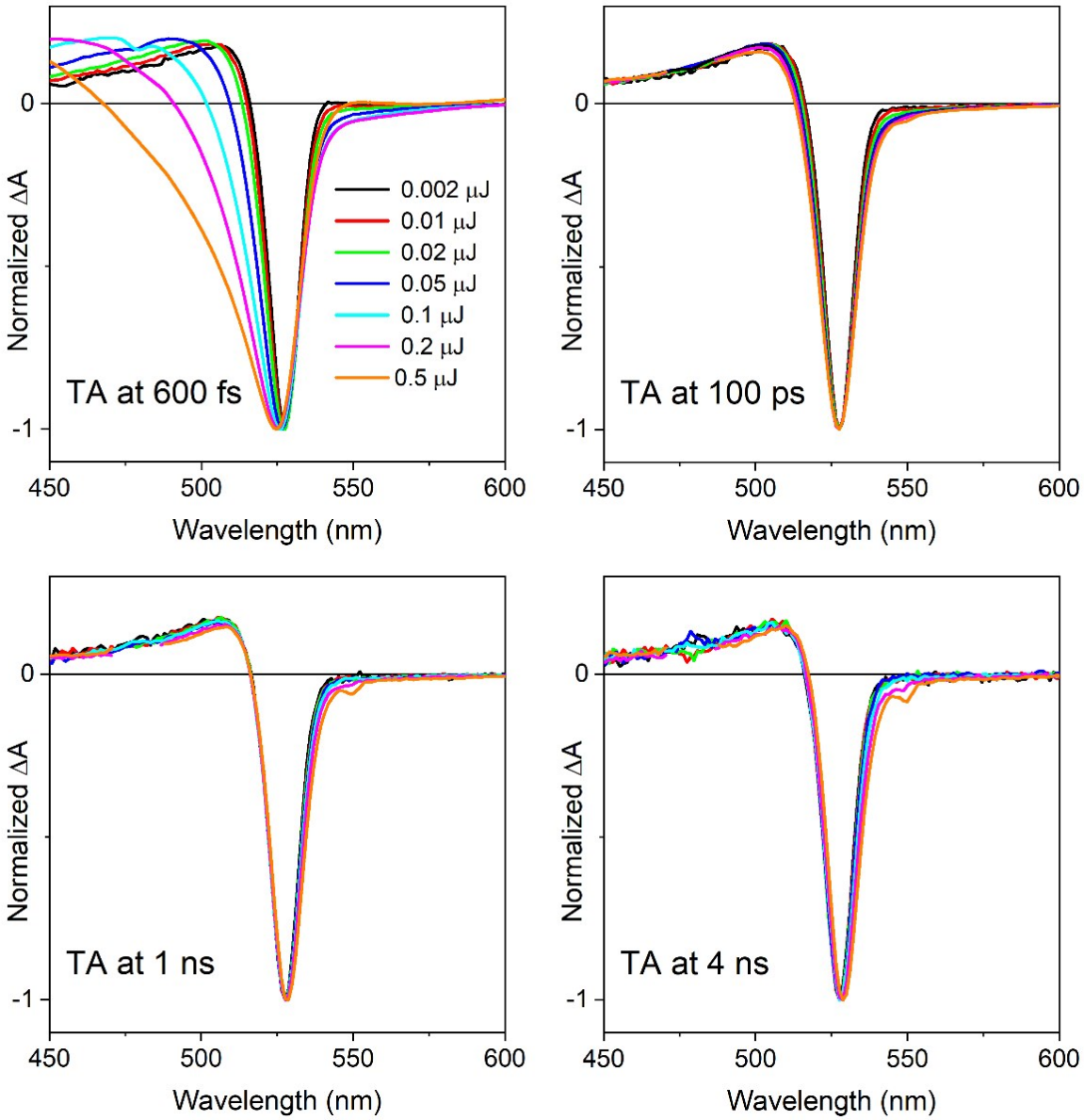

Figure S6. Exemplary transient absorption (TA) spectra of the perovskite film taken at several delay times after exciting at 490 nm with various excitation intensities (energies).

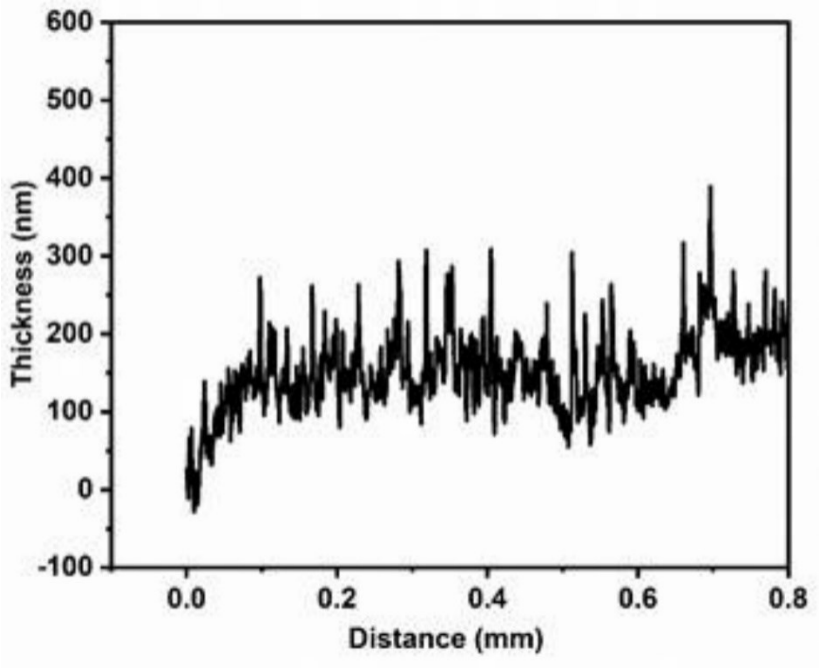

Figure S7. Profilometry of the RVPP-PEDOT film deposited on the FTO support.

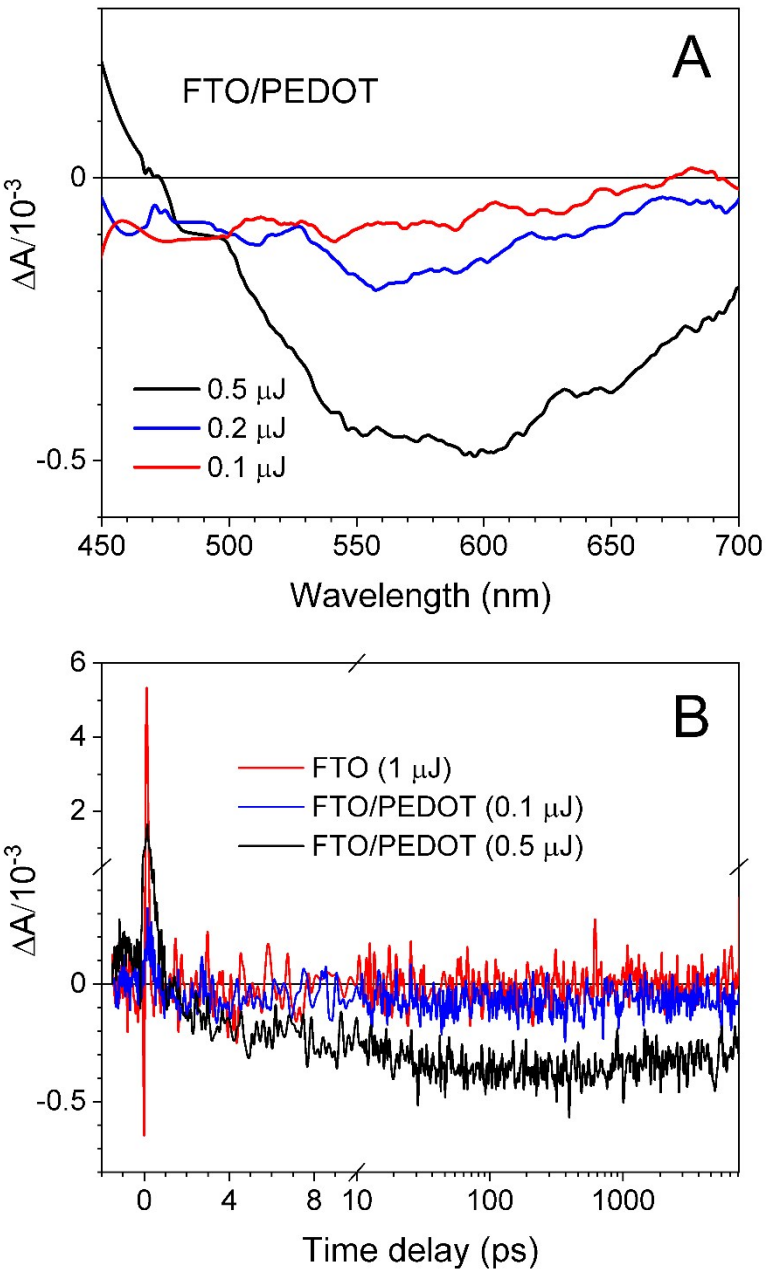

Figure S8: Transient absorption of RVPP-PEDOT film upon excitation of 490 nm. (A) TA spectra taken at 100 ps after excitation for three exemplary excitation intensities/energies. (B) Selected kinetic traces taken approximately at wavelength corresponding to bleaching minimum. For comparison negligible TA signal for FTO plate is shown.

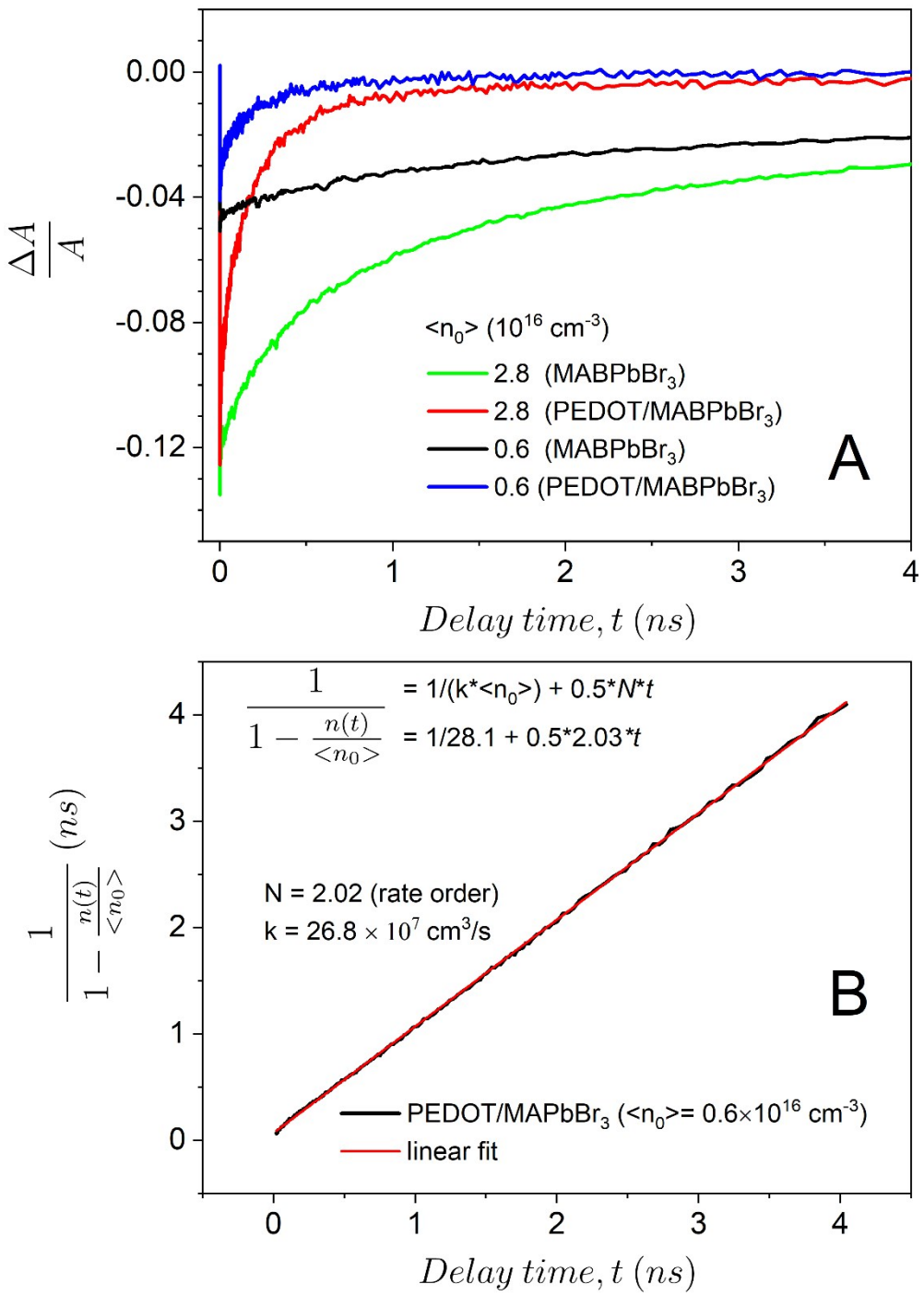

Figure S9. Comparison of RVPP-PEDOT/$MAPbBr_3$ and $MAPbBr_3$ TA signal decays (dynamics of overall charge recombination) of comparable amplitude. (A) Selected TA traces for both samples with comparable initial charge density n_0; (B) Analysis of rate order decay of RVPP-PEDOT/$MAPbBr_3$ TA signal (charge recombination).